Pediatric Prehospital Protocols Grant
Post-Resuscitation Management
Evidence-Based Practice Summary

Evidence-Based Practice Summary prepared by Colleen Jones, MSN, RN, Research Specialist and Janelle Smith, MS, RN, Research Specialist.

ASK THE QUESTION

**Question 1:** In the post resuscitation management of the pediatric patient in the prehospital setting who has not been previously intubated, how does intubation compare with bag valve mask ventilation in terms of improved outcomes (mortality upon arrival to the EC, 30 day mortality, neurologic outcome,)?

**Question 2:** Does therapeutic hypothermia compared to no intervention in the post resuscitation management of the infant (non-neonate) or child in the prehospital setting result in better outcomes (mortality upon arrival to the EC, 30 day mortality, neurologic outcome)?

**Question 3:** Does therapeutic hypothermia compared to no intervention in the post resuscitation of the neonate in the prehospital setting result in better outcomes (mortality upon arrival, 30 day mortality, and neurologic outcome)?

**Question 4:** Does pulse oximetry monitoring with titration of oxygen delivery improve outcomes (mortality upon arrival to the EC, 30 day mortality, and neurologic outcome) in the post resuscitation management of the neonatal patient in the prehospital setting?

CRITICALLY ANALYZE THE EVIDENCE

**Existing External Order Sets/Guidelines/Clinical Pathways**

<table>
<thead>
<tr>
<th>External Guideline/Pathway/Order Set</th>
<th>Organization and Author</th>
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<tr>
<td>Pediatric Advanced Life Support: 2010 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care</td>
<td>American Heart Association</td>
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<tr>
<td>Neonatal Resuscitation: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations</td>
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The two published clinical guidelines have been evaluated for this review using the AGREE criteria. AGREE includes evaluation of: Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence. Four reviewers appraised the guideline, and
scored each component independently. Domain scores were calculated by summing up all the scores of the individual items in a domain, and standardizing the total as a percentage of the maximum possible score for a particular domain. After appraising the guidelines above using the AGREE instrument, the reviewers recommend using the guidelines with modifications. The reviewers were: Elizabeth Crabtree, MPH; Quinn Franklin, MS, CCLS; Colleen Jones, MS, RN; and Janelle Smith, MSN, RN.

**Question 1:** In the post resuscitation management of the pediatric patient in the prehospital setting who has not been previously intubated, how does intubation compare the bag valve mask ventilation in terms of improved outcomes (mortality upon arrival to the EC, 30 day mortality, neurologic outcome, ICU LOS)?

**Recommendation:** In the post resuscitation management of the pediatric patient in the prehospital setting, bag valve mask ventilation is preferred over endotracheal intubation to enhance improved outcomes.

**Strength of recommendation:** Weak

**Grade criteria:** Very low quality evidence

The use of Bag-valve mask in the prehospital setting has been shown to improve oxygenation and/or ventilation to help prevent the need for endotracheal intubation. The Pediatric Basic and Advanced Life Support (Kleinman, et. al. 2010) recommends bag-valve mask over tracheal intubation for children and infants needing ventilatory support in the prehospital setting. This recommendation is supported by evidence via seven studies completed in the prehospital setting. Gausche 2000 and Pitette 2002 found no significant difference between survival to hospital discharge for children intubated or when bag-valve mask was used for ventilatory support. Ehrlich 2004, Gerritse 2008, Garza 2005, Coldwell 2009, and Stockinger 2003 all demonstrated significant clinical data showing children intubated in the field had decreased survival rate to the Emergency Department, lower Glasgow Coma Scale Scores, and no improvement in neurological deficits at discharge. The three study Lecky 2008 Cochrane Review was not utilized in this evidence summary. Two of the three research trials from this Cochrane review were adult trials for out-of-hospital cardiac arrest. One study compared physician intubation versus a Combitube. The second trial looked at paramedic intubation versus an esophageal gastric airway. Therefore, the Gausche 2000 trial, the third study was reviewed separately, graded, and incorporated into the evidence summary. The Gausche study had the best study design of those reviewed. In this study, there was no significant difference in survival or neurologic outcome between the bag-valve-mask (BVM) and endotracheal intubation (ETI) groups. Since some of the other studies reviewed also demonstrated complications such as malpositioned endotracheal tubes, there is potential risk for harm with ETI in the prehospital setting, when compared to BVM.

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<tr>
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**References:**


**Guideline Reviewed:**

**Question 2:** Does therapeutic hypothermia compared to no intervention in the post resuscitation management of the infant (non-neonate) or child in the prehospital setting result in better outcomes (mortality upon arrival to the EC, 30 day mortality, neurologic outcome)?

**Recommendation:** Therapeutic hypothermia is not recommended in the post-resuscitation management of the infant (non-neonate) or child in the prehospital setting.

**Strength of recommendation:** Strong

**Grade criteria:** Low quality evidence

In an observational study by Doherty, et al., the use of hypothermia was evaluated compared to no intervention in both the Pre-hospital and In-hospital setting. Based on the study results, the use of hypothermia was contraindicated due to the increase mortality rate, 30 day mortality rate and neurologic outcomes of the patients.

Fink, et al. (2010) conducted the largest retrospective cohort study known on the use of therapeutic hypothermia in pediatric cardiac arrest. It was found that the use of therapeutic hypothermia is acceptable if the target temperature was met in less than 3 hours. In this study, the target temperature was set to 34.0°C. Increase cases of mortality was found when the temperature fell below the target.

**Recommendation(s): Low Quality Evidence**

<table>
<thead>
<tr>
<th>Number of Studies: Total #</th>
<th>2</th>
<th>Systematic review</th>
<th>□ RCT</th>
<th>☑ Observational</th>
<th>□ Case Reports</th>
<th>Publication Bias Evident</th>
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<td>□ Outcomes measured (Fink 2010)</td>
<td>□ Comparisons not applicable to question/outcome</td>
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<td>□ Sample CI/RR</td>
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**Doherty (2009):** Observational Study. 79 patients were enrolled in the study. 29 of 79 patients received hypothermia therapy. 50 of the 79 patients were assigned to the Control (normothermia) group.

**Fink (2010):** A Retrospective, cohort study. 181 patients were included in the study. 141

**Doherty (2009):**
- Temperature within the first 12 hours after cardiac arrest was significantly lower in the hypothermia therapy group than in the normothermia group (P<0.001)
- Mortality was higher at 6 months in the hypothermia group (69%)
40 out of the 181 patients were in the hypothermia group. 38% of the patients in the hypothermia group had a PCPC score of 1 to 3 before cardiac arrest who had a PCPC score of 4 to 6 after cardiac arrest was higher in the hypothermia group (65%) than in the normothermia group (37.8%); P=0.060. Longer length of stay in the pediatric intensive care unit (PICU) was 16.0 days compared to 9.0 days in the hypothermia therapy group than in the normothermia group; P=0.411.

Fink (2010):
- In the therapeutic hypothermia group, where the temperature fell below < 32deg C occurred in 15% of patients and was associated with higher hospital mortality; p=.02.
- In the therapeutic hypothermia patients where the temperature stayed within the median target of 34.0, there was no significant difference in the mortality rate; p=1.0.

References:

Question 3: Does therapeutic hypothermia compared to no intervention in the post resuscitation of the neonate in the prehospital setting result in better outcomes (mortality upon arrival, 30 day mortality, and neurologic outcome)?

Recommendation: Therapeutic hypothermia is recommended in the post-resuscitation management of the neonate in the prehospital setting.

Strength of recommendation: Strong
Grade criteria: Moderate quality evidence

Several Randomized Controlled Studies evaluated the use of induced hypothermia in neonates for the treatment of neonatal encephalopathy. Based on the study results, the use of induced hypothermia in neonates could improve survival and lead to less neurological long term defects.

Perlman, et al. (2010) discusses in the 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations that infants born at or near term with evolving moderate to severe hypoxic-ischemic encephalopathy should be offered therapeutic hypothermia.
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of hypothermia was noted on outcome (p=0.51).

**Shankaran (2005):**
- 24 deaths in the hypothermia group and 38 deaths in the control group; RR, 0.68; p= 0.08.
- Death or disability among infants with moderate encephalopathy is 22 (32%) in the hypothermia group and 30 (48%) in the control group. RR=0.69; p=0.09.
- Death or disability among infants with severe encephalopathy is 23 (72%) in hypothermia group and 34 (85%) in the control group. RR=0.85; p=0.24.
- The rates of disabling cerebral palsy were 19 percent in the hypothermia group and 30 percent in the control group; RR=0.68; p=0.20.

**Wyatt (2007):**
- Greater severity of EEG background changes, presence of EEG seizures, lower continuous 5-minute Apgar score and greater birth weight were associated with adverse outcomes.

**References:**

**Question 4:** Does pulse oximetry monitoring with titration of oxygen delivery improve outcomes (mortality upon arrival to the EC, 30 day mortality, and neurologic outcome) in the post resuscitation management of the neonatal patient in the prehospital setting?

**Recommendation:** Routine use of pulse oximetry to titrate oxygen delivery to neonates for post-resuscitation management is not recommended for the term infant. For infants with estimated gestational ages of < 32 weeks born in the prehospital setting, pulse oximetry should be used to titrate oxygen delivery to gradually achieve an oxygen saturation of 90-99% over 10 minutes, if pulse oximetry is available.
Recommendation: Strong
Grade criteria: Low quality evidence

One randomized controlled study and one observational study evaluated the use of Oxygen in neonates (< 32 weeks) after delivery. In the randomized controlled study, it was suggested that room air or 21% oxygen should not be used because it does not successfully oxygenate the infants and SPO2 levels did not reach targeted ranges until oxygen delivery was increased. In the observational study, it was suggested that excessive oxygen delivery after birth in neonates increases the risk for negative consequences and lower oxygen levels are more beneficial.

Perlman, et al. (2010) discusses in the 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations the use of Supplemental Oxygen in neonates. It is recommended that pulse oximetry be used to guide the delivery of oxygen since most preterm babies (< 32 weeks) will not reach target saturations. However, in term infants who received resuscitation with intermittent positive pressure ventilation (PPV), administration of 100% did not provide an advantage and may be potentially harmful. In addition, infants resuscitated with room air, rather than routine supplemental oxygen, had decreased mortality.

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Sample CI/RR
**Escrig (2008):** N= 42 infants. 19 were in the Low-Oxygen group and 23 were in the High Oxygen group

**Wang (2008):** N= 43 infants. 23 were in the Oxygen group, 18 were in the room air group and 2 did not require resuscitation.

**Escrig (2008):**
- In the first 3 and 4 minutes after birth, FIO2 in the high-oxygen group was significantly higher than that in the low-oxygen group (P < 0.1). After 4 minutes, there was no significant difference between values.
- No deaths occurred in either group in the neonatal period (<28 days).
- 4 infants in the low-oxygen group and 3 in the high-oxygen group died as a result of respiratory or neurologic complications during hospitalization.
- No significant difference between the groups in the incidence of acute and/or long-term complications were detected at discharge.

**Wang (2008):**
- In the room air group, FIO2 was increased directly to 100% because of bradycardia by 2 minutes of age for 6 patients and FIO2 was increased incrementally for failure to meet SPO2 criteria at 3 minutes of life for the remaining 12 patients.
- There were no significant differences in any of the evaluated outcomes, including intraventricular hemorrhage, retinopathy of prematurity, necrotizing enterocolitis and chronic lung disease.
- In the Oxygen group, an infant of 25 weeks of gestation died at 7 days of life as a result of sepsis, respiratory distress syndrome and pneumothorax.
- In the Room Air group, an infant of 24 weeks of gestation died at 3 days of life as a result of respiratory failure, pulmonary hemorrhage and grade IV intraventricular hemorrhage.

**References:**